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Gas Journal

VOL. 308 113th YEAR LONDON, DECEMBER 6, 1961 No. 5127 PRICE 1/9

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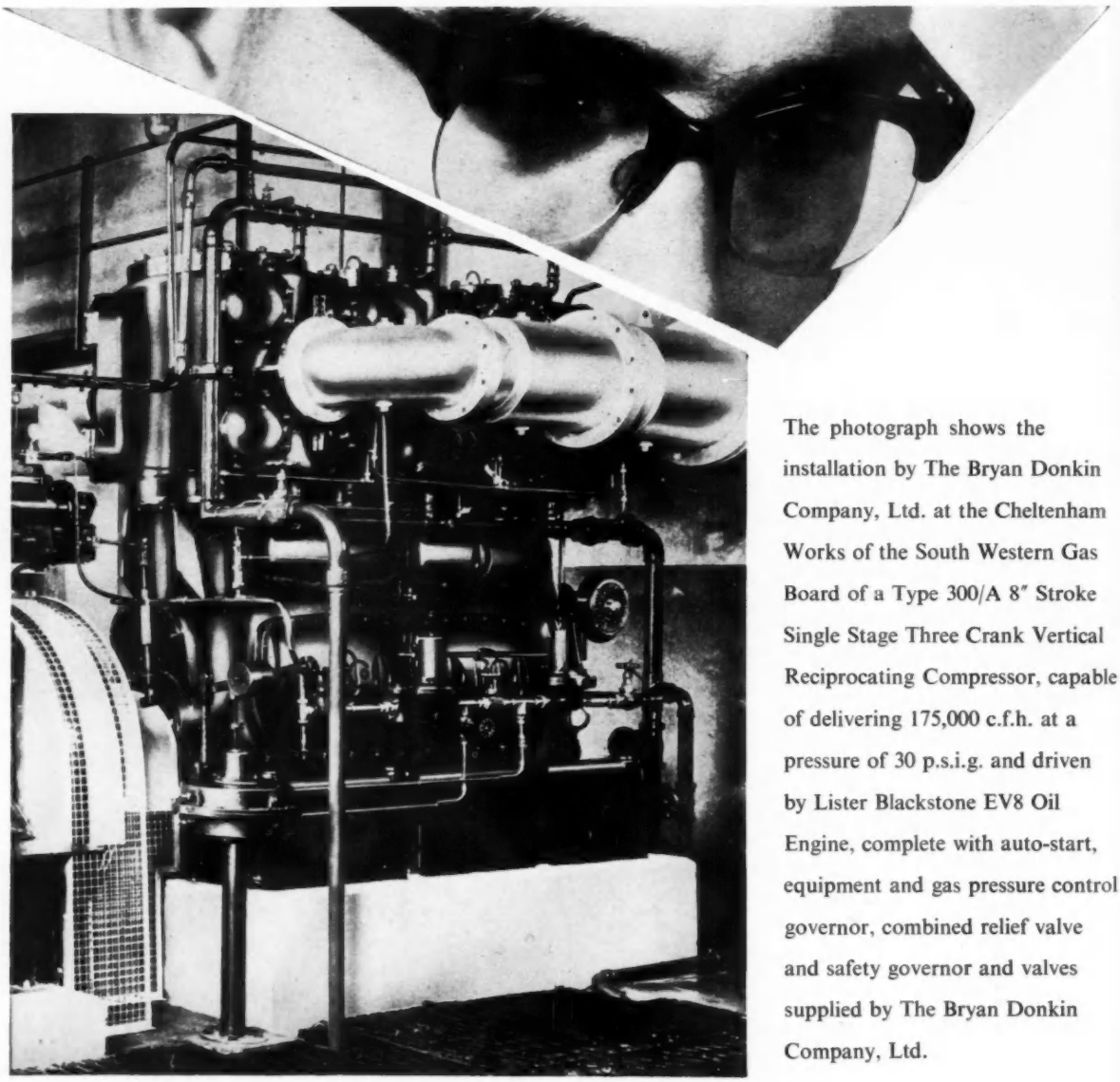

The photograph shows the installation by The Bryan Donkin Company, Ltd. at the Cheltenham Works of the South Western Gas Board of a Type 300/A 8" Stroke Single Stage Three Crank Vertical Reciprocating Compressor, capable of delivering 175,000 c.f.h. at a pressure of 30 p.s.i.g. and driven by Lister Blackstone EV8 Oil Engine, complete with auto-start, equipment and gas pressure control governor, combined relief valve and safety governor and valves supplied by The Bryan Donkin Company, Ltd.

Photograph by courtesy of The South Western Gas Board.

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Gas Journal

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WEDNESDAY, DECEMBER 6, 1961

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production of gases for metal treatment atmospheres
production of gases for organic hydrogenation processes

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Gas Journal

COKE OVENS • BY-PRODUCTS • CHEMICALS

An aquifer in Great Britain?

THE underground storage of town gas is surely one of those modern tools of gas distribution that many think may be the panacea of the frustrations of the gas industry as it faces renewed and more severe competition.

Mr. C. Johnson's paper, 'Gas Reservoirs in British Porous Rock Structures,' which we listened to at the final session of the recent Autumn Research Meeting of the Institution, is therefore timely in that it so fully yet concisely brings into focus all the available facts. In the abstract which we are publishing this week we have attempted to retain the overall picture presented by the author, while omitting for lack of space the somewhat specialised information on geology with which Mr. Johnson explains the kind of quest facing the Gas Council and the exploration company. We feel that most of our readers will be more interested in a broad description of the types of underground structure now being used by the gas industry in Europe and America, and the type of material that can be stored, rather than a description of the structure and formation of the ground in which reservoirs can eventually be located.

We found the discussion that followed the paper most apposite, since a number of points emerged which were new to us. Dr. A. E. Haffner's closely argued analysis of the conditions under which underground storage would be economic brought out a number of additional points which need to be carefully studied. His description too of the filling of the proposed aquifer near Winchester brought home to us that commissioning of these structures cannot be contemplated without a very exact knowledge of what is actually happening as the incoming gas starts to displace the water.

Mr. G. U. Hopton's and Mr. A. B. Densham's contributions revealed quite another set of problems which the chemists have to solve, namely the possible contamination of water supplies in the locality of an aquifer, and the necessity or otherwise of installing additional gas purifiers before the gas enters the reservoir, and any change in the chemical composition of the gas while it is there.

Mr. L. J. Clark, himself one of those responsible for the success of the import of liquid methane by the Methane Pioneer, was able to give a considered view of the problems which the storing of therms for the seasonal and peak loads might solve.

Here then both engineer and scientist are contributing to the success of this very bold project.

Britain, though well endowed with some of the best coal in the world, is singularly lacking in oil or natural gas and, in consequence lacks the ready-made structures in which to store them. The explanation put forward by the geologist Mr. N. L. Falcon, of the B.P. Exploration Co. Ltd., was that this country had undergone so much more geological disturbance during important periods of geological time, than other parts of the world where liquid and gaseous hydrocarbons were to be found in quantity, that the natural storages had been destroyed and their contents dispersed.

But what effect will the use of an aquifer have on gas supplies? Undoubtedly if a large enough volume of gas can be stored and an efficient trunk distribution system laid out, the base loading of plant can be extended, all production plant used at a more economic load factor, and a great deal of obsolescent plant put out of commission.

What will be the cost of storing really immense volumes of gas for perhaps seven months of the year? This is something of a problem. Mr. Clark mentioned 4d. a therm for the Beynes aquifer near Paris and Dr. Haffner stressed the cost per year of storing in conventional holders at 1d. per therm per day. However, the cost of developing an aquifer is estimated at only 1/250-1/300 of the capital costs of the corresponding above ground storage. The particular conditions operating in Britain compared with France, over the whole field of production and distribution, may well mean that the use of an aquifer will effectively—and economically—solve the growing tendency of the winter: summer ratio of gas consumption to rise, by allowing surplus gas to be stored in summer time.

Finally, we would stress that a large available reserve of gas standing by for the months of heavy consumption during the winter is a dream beyond the wildest imagination of the gas engineers of a past generation.

Accent on advertising

An examination of the proceedings of the Gas Sales and Service Conference at Harrogate reveals that the most frequently recurring subject was advertising. There were pleas for more expenditure on advertising this type of appliance or that; there were those who wanted harder-hitting copy and those who warned against it; and there was the suggestion that advertising should be keyed more closely to the workings of the feminine mind. But it is worth noting that there was virtually no real criticism of existing Gas Council advertising—a very encouraging sign and, in our view, the result of the high standard now being achieved.

Mr. W. R. Bowden, the Chairman of the Institute of Marketing and Sales Management, thought that the Gas Council should be entirely responsible, through an agreed strategic policy, for promoting the image of gas and its fulfilment of basic needs; an agreed allocation per load should be determined and allocated to the boards. He suggested that a national approach might well be for the area boards to base their contributions on the margin of appliance sales at the rate of (say) 2.5-2.7% of estimated and budgeted sales of appliances. He thought television should be included in the industry's list of media.

Strategically, he said, advertising for the industry must improve the image of gas in the minds of the public; increase sales in the domestic field; hold the cooker load and, if possible, improve it; develop the enormous potential for water heating; exploit the potential for other domestic loads. And he added that it should use terminology which had real purpose—space heating sounded as though it was something for astronauts!

There seemed to be general agreement that the appliance needing the most advertising support was the cooker, and here the contributor offering the most specific advice was Mr. G. M. Barris, Publicity Officer of the Eastern Gas Board. He favoured the kind of co-operative space sharing programme with leading manufacturers practised by the American Gas Association, referring to specific brands and mentioning specific features.

Mr. Barris therefore came up with the following interesting suggestion: 'It might be that there is not sufficient money available at the moment to devote solely to this extremely important market. Arrangements might therefore be made between the industry and the appliance makers to uplift the selling price of all cookers by £1 each. The administration of this levy would not be difficult and at current levels would give an advertising "fighting fund" for cookers of the order of some £600,000 a year—which would increase with success'.

Unfortunately no direct comments on this suggestion were recorded at Harrogate, but we sought the opinions of senior executives of two cooker manufacturers. Said one: 'Surely this is the negation of advertising which is aimed at *reducing* the price of the product?' Said the other: 'A £1 uplift is not nearly enough. One of the gas cooker's greatest handicaps is that it is cheaper than the electric cooker'.

So there you are. You pays your money and you takes your choice. But the sooner the matter is the subject of top-level discussion, the better.

No such discussion is likely to take place without Mr. R. J. Gregg, the Publicity Manager of the Gas Council, and it would be interesting to see whether he would regard the increased appropriation as an opportunity to break into television advertising. At the moment there is little cooker advertising of any kind on T.V., and participation by gas might bring with it the risk of large-scale retaliation by the electric cooker manufacturers.

BRIEFLY . . .

Christmas Lecture

That admirable event, the I.G.E.'s Christmas Lecture for Young People, will be given this year by Mr. T. A. Lucas whose subject, 'The Nerves of an Industry' will embrace the demonstration of devices for imitating the senses of sight, touch and hearing, and the illustration of systems which will calculate and remember. These techniques are shown in the context of centralised gas production. The lecture will be held in the Main Chemistry Lecture Theatre of the Imperial College of Science and Technology, South Kensington, London, S.W.7. on January 2, 1962 at 2.30 p.m.

Tickets may be obtained from the Secretary of the Institution, 17 Grosvenor Crescent, London, S.W.1. Accommodation is limited to approximately 250.

Keep off the white lines!

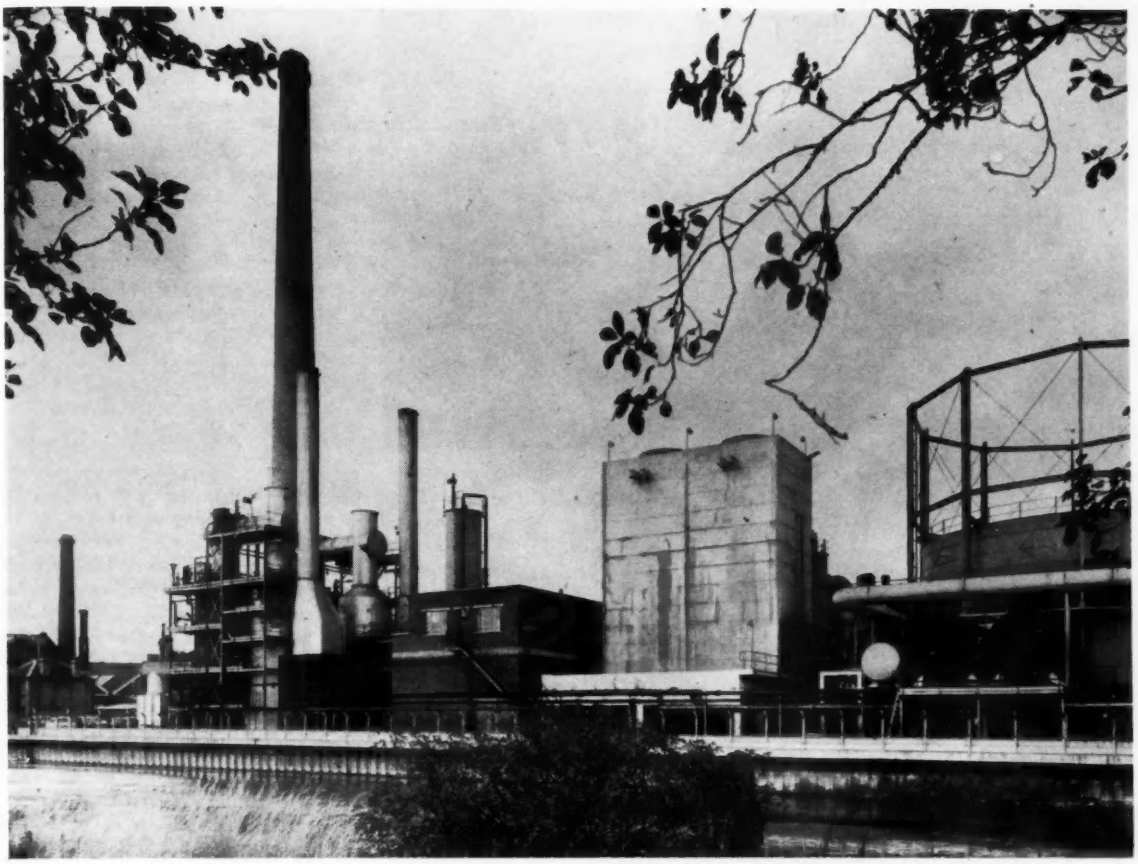
Well-kept gasworks are not only good for the industry's morale but help to improve the face we present to the public. The Eastern Gas Board lays considerable stress on the importance of their Best Kept Works Competition, won this year by Ipswich Works Engineer, Mr. F. J. Denny. However, it seems that the competition had its critics and when the Deputy Chairman, Mr. F. T. Brookes, presented a plaque to the runners-up, Ponders End, he took the opportunity to defend the scheme. We particularly liked, and endorsed, his comments on fussy window dressing. Marks were never given to people who painted white lines, he said. In fact so critical was the assessment that marks were not infrequently taken off rather than put on!

No. 1. salesman for gas

When Sir Henry Jones first became Chairman of the Gas Council he told us that he considered himself a salesman and would lose no opportunity of telling the world what gas can do. He has certainly carried out his promise and seldom makes a speech without slipping in a 'commercial.' Sir Henry's address to the Yorkshire Section of the Institute of Fuel recently was essentially a concise and factual statement of the industry's position, but even here he managed—without in any way diverging from his proper course—to bang the drum on behalf of the gas room heater. One can hardly imagine a finer ambassador.

Silent service

The North Thames Gas Board might have argued that the whistling noise caused by high-speed pumping at their Romford works, which according to the *Evening Standard* kept people awake at night, was a kind of publicity, reminding listeners that Mr. Therm burned to serve them. Happily, however, they decided to spend money and take the pea out of the whistle. We think they are wise—gas is best thought of as a silent service.



The new Power-Gas plant from across the Kennet. The Segas plant is on the left, and the control room in the centre next to the induced-draught water coolers. The sheet-piled bank of the Kennet stands out clearly.

Power-Gas build new Segas plant at Reading

THE reorganisation and extension of its distribution system by the Southern Gas Board, and the decision not to replace the works at Oxford by a new manufacturing station at Cowley, has enabled the number of production plants in the Board's area to be reduced to a total of six; one of these at Kingston, Isle of Wight, is responsible for the manufacture of all gas in the island.

On the mainland gas production is confined to works at Southampton, Poole, Portsmouth, Reading and Camberley which feed into the backbone main running in a northerly direction from Poole in the south-west of the area, to Ipsden, near Wallingford in Berkshire, where the branch from Reading and Camberley joins it to supply the northern areas of the Board; gas manufactured at either of the two later stations, could in an emergency be pumped southward.

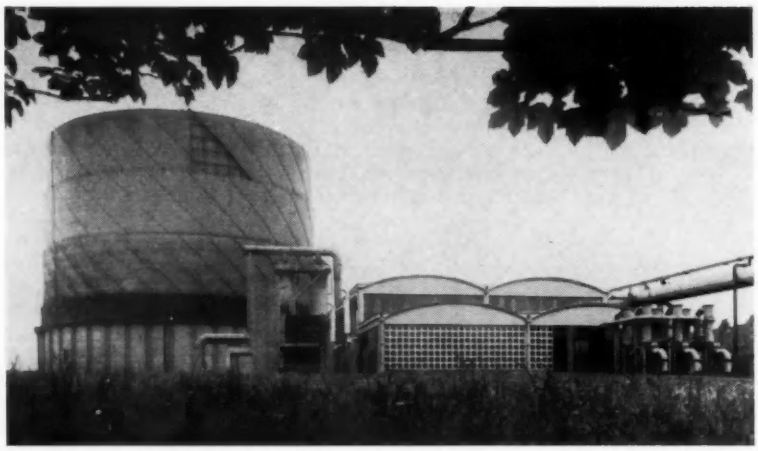
The new Segas plants at Reading have increased gas production capacity there by 7 mill. cu.ft. per day.

Existing plant at this works consists of continuous vertical retorts with a capacity of 12 mill. cu.ft. per day and a carburetted water gas plant capable of a further 7.5 mill. cu.ft. per day. The total gas available will therefore be some 24 mill. cu.ft. per day.

Since there is no manufacturing plant in the Board's area north of Reading, this works has become increasingly important for the supply of gas to its northern section, known as the Oxford Region, which is situated principally in the counties of Oxford and Berks, and the Buckinghamshire border, including important and fast developing towns such as Bletchley, Leighton Buzzard and Aylesbury.

In addition therefore to the new manufacturing plant at Reading, gas distribution plant has also been installed there which includes a new gas holder of 5 mill. cu.ft. capacity, a new compressor and boosting plant, together with the laying of a new steel high-pressure main to Cowley, which reinforces the existing high pressure main to Oxford running through Didcot and Abingdon with a branch to Wantage.

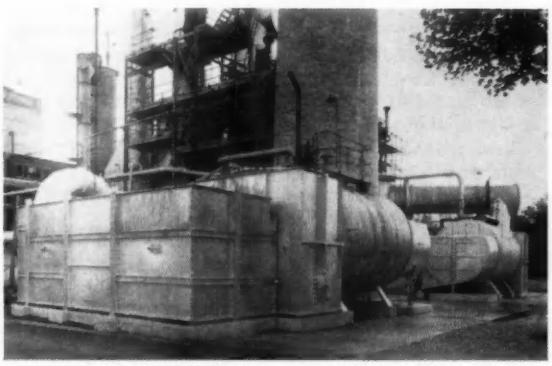
Camberley is connected to Reading by a main running through Wokingham, and is therefore an additional source of gas to this region, and both are reinforced by the 'backbone main' where it joins the new Reading to Cowley



The plant over the Kennet, showing the new compressor house with its barrelled roof, the gas drying plant on the left and the aftercoolers on the right. The new holder is obscured by an existing holder of the same capacity.

main at Ipsden. Pressure and flow measurements are telemetered from Ipsden to the control room at Reading, from which valves under remote control can be operated to allow gas to pass from the backbone main into the Reading Region's network.

Inside the compressor house control room, showing the indicating and recording instruments on the left of the panel, and the control and measuring instruments for the main at Ipsden on the right.



The waste heat boiler plant. In the right background is the boiler of the existing pair of Segas sets and in the foreground the combustion chamber for the oil-fired boiler, available for a further plant, if built.

The new Segas plant for which the civil engineering work was carried out by Wests' Piling and Construction Co. Ltd., consists of one pair of 2-vessel units, worked cyclically but in combination giving as nearly as possible a steady gas output; each unit when gasifying medium fuel oil of 950 seconds' viscosity has a capacity of 3½ mill. cu.ft. per day, and has been adapted to gasify light gasworks feedstocks by way of replacement of fuel oil with an increase of output of 4 mill. cu.ft. per day. Space has been left to install a similar pair of units of the same capacity at some future date if demands for gas should justify it.

The gas-making section of the plant consists of a combined steam preheater and vaporiser, and a combined reactor and air preheater. The former is a mild steel cylindrical vessel, refractory lined, 38 ft. high by 12 ft. in diameter. The steam preheater section contains chequers to retain the heat received from the reactor vessel during the 'blow' period, and is connected to the vaporiser section by a 6-ft. diameter throat.

Reactor and air preheater

The combined reactor and air preheater is a similar vessel, 33 ft. 9 in. high and 12 ft. in diameter. It is divided by a honey-comb refractory dome providing a support for the catalyst. The air preheater also contains refractory chequers. There are connections for primary air and purge steam.

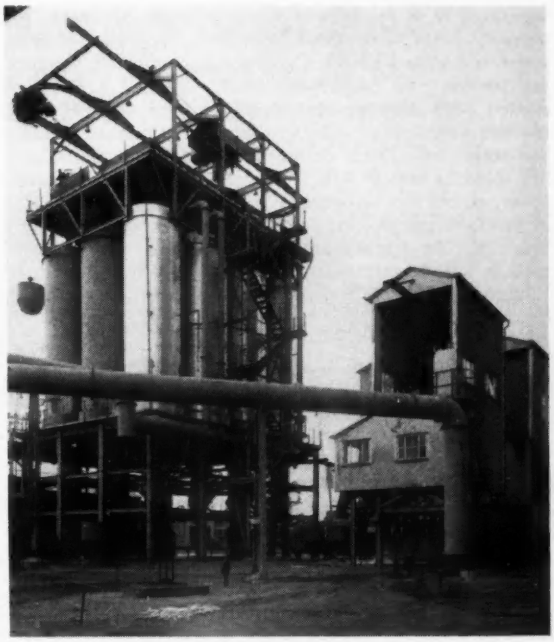
The catalyst is of the lime-magnesite type but incorporates 6-8% of nickel and 1% of iron. It is in the form of rings of two different diameters. The top and bottom of the bed contains 3 in. of large rings while the main part consists of 1½-in. rings to a depth of 4 ft. The total weight of catalyst in each plant is 18 tons. Each plant has its own wash box 17 ft. by 8 ft. by 5 ft. 6 in. deep, of the self-cleaning type through which 6,000 gal. of water per hour are circulated. The gas made in both plants passes to a Lymn washer, 9 ft. in diameter by 55 ft. 6 in. high through which water is circulated at the rate of 35,000 gal. per hour. Working in conjunction with this washer are two twin-cell concrete cooling towers of the wood filling splash type with induced draught, capable of cooling 35,000 gal. of water per hour from 112° F. to 60° F., at a wet bulb temperature of 52° F. Provision has been made for a further two similar towers.

From the Lymn washer, the gas flows to the naphthalene washer a 6-bay mild steel vessel—with a wood filling supplied by Whessoe Ltd., through which creosote washing

medium is circulated; the naphthalene content of the gas is thus reduced from 50 grains per 100 cu.ft. to 1.5 grains.

The exhausters, two Waller-Rootes steam-driven machines, with a capacity of 350,000 cu.ft. per hour—8.4 mill. cu.ft. per day—pass the gas through the electrostatic detarrer from the relief holder, which was transferred to Reading from another works and is a two-lift, column guided holder of 150,000 cu.ft. capacity.

Gas purification is by the Gastechnik process, and the installation, supplied by Robert Dempster & Sons Ltd. consists of four streams, each of three towers, with a total capacity of 8 mill. cu.ft. per day, a screening plant for the special oxide pellets, and a sulphur extraction plant using perchlorethylene. The ultimate product, block sulphur, is recovered in a state of 97.5% purity. The purified gas is metered in a 22-in. by 66-in. Holmes-Connersville meter of 10 mill. cu.ft. per day capacity.



The Gastechnik purification plant, showing on the left the four three-tower absorption units, and on the right the building containing the screening plant for the pellets and the extraction plant for the sulphur.

Steam raising

Steam is raised at the two Segas plants by one common horizontal multitubular waste heat boiler, 10 ft. in diameter by 13 ft. long working at 130 p.s.i.g., and raising 10,600 lb. of steam per hour when gasifying medium fuel oil, and an exactly similar boiler—the waste heat boiler for a second pair of gas-making plants—but fitted with a refractory combustion chamber and oil-fired; its steaming capacity is 15,750 lb. per hour. Waste gases from the two boilers pass to a 205-ft. brick stack, which has been designed to serve the two additional sets at some future date.

Low pressure steam is recovered from the exhausts of the engines driving the air blowers, exhausters and other ancillary machinery, and is collected in a steam accumulator 8 ft. 6 in. in diameter by 30 ft. long, capable of a discharge rate of 24,000 lb. per hour at pressures varying from 25 to 15 p.s.i.g.

Air for the 'blow' period is obtained from two fan type blowers— one standby and with provision for a third—one of which is driven by a 200-h.p. electric motor and the other by a steam turbine of 225 h.p. To avoid complaints of excessive noise from the immediate neighbourhood of the works, the blower-room and a short section of the blast main have been sound-proofed.

At first floor level in the same building is the control room in which are located the hydraulic operators for the Segas plant; it is fully instrumented, and in addition certain adjustments can be made to the plant by six hydraulically-operated valves remotely controlled from here. In the control room too, are the steel cabinets containing high pressure oil cylinders for the hydraulic operators, and the transformer-rectifier for the detarrer.

Beyond the control room in the same building is the amenity section for the men working on this plant and consists of a mess room, clean and dirty locker room, a shower and W.C.

The four Bryan Donkin reciprocating compressors. Where practicable the plant at this new compressing station has been placed outside as much as possible.

Underneath the cooling towers at ground level are the pumps for the boiler feed water, oil for gas making and for the oil-fired boiler, the Lymn washer pumps and the cooling tower water pumps.

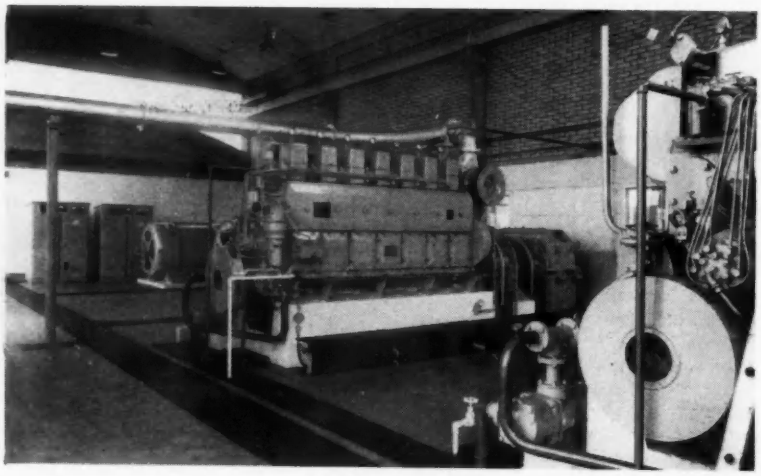
Tar and liquor carried from the washer by flume are

separated in a rectangular concrete tank of 60,000 gal. capacity. Amine is added to improve separation and the water in a closed circuit is pumped back through the cooling towers. To reduce the acidity of this water, it is treated with sodium carbonate, so that the *p*H value remains constant at 6.0-7.0, though the pumps handling this water have been designed to deal with liquor of a *p*H value as low as 4.0. A proportion of the circulating water, equivalent to between 1 and 3 gal. per 1,000 cu.ft. of gas made, is bled to the sewer after passing through a coke filter to remove any traces of oil. Tar is stored in two 20,000 gal. overhead tanks. Make-up water is obtained from the steam purge at the gas-making plant.

The storage tanks are dipped by a steel tape passin through a wooden plug in the top of the tank whic insulates the attendants who have been previously earthed.

To connect this site with the main part of the works, tw thrust bores, undertaken by William Press & Sons Ltd., have been made under the Western and Southern Regions' main lines. Each is 400 ft. long, the longest so far i this country, and contains an 18-in. steel tube, passing a a safe depth below the permanent way. In one tube i carried an electric cable, a water pipe, a telephone cable and a spare 4-in. pipe, and in the second a p.f.d. service to the works, one return, and two spare 4-in. pipes.

The electrical power services throughout the works have



The interior of the compressor house showing the two 500-h.p. National diesel engines driving two of the compressors; one of the electric motors driving a third compressor can be seen in the background.

Medium fuel oil is delivered by road tanker and pumped to a ½ mill. gal. mild steel, riveted storage tank—equivalent to two week's consumption at full output—and pumped to the gas-making plant as required. Light gasworks feedstock is stored in two ¼-mill. gal. all welded steel tanks erected on King's Meadow, a newly purchased 15-acre site on the further side of the two main line railways and well away from the works. On this site too are the pipe stores, and space has been provided for stocking 30,000 tons of coal and the same quantity of coke.

These two storage tanks, constructed by Oxley Engineering Co. Ltd., are surrounded by a bund, divided into two sections, each with a capacity equal to 120% of the tank it contains. Foam from a suitably located fire station can be pumped into the top of the tanks; clean water for cooling purposes is also connected by two pipelines to the top of each tank. In addition hydrants placed at convenient points, and supplied by a 9-in. water main, supply clean water and/or foam in case of emergency. The immediate vicinity of the storage tanks is fenced off by a chain-link fence, except on the north side adjacent to the tanker unloading point, which is carried out in aluminium sheeting.

The light gasworks feedstock is brought from the Esso refinery at Fawley near Southampton in block trains of 20 tank wagons, and unloaded in less than 12 hours. Provision has also been made for delivery by road tanker if the need should arise. The rail tankers are earthed and connected by flexible couplings to an 8-in. line reducing to 4 in. in diameter at the furthermost point, through which the contents are pumped out. The pipes are bonded throughout.

been considerably extended, and the present capacity has been increased from 500 kVA to 2,500 kVA. This has involved setting up five substations, which are located at the point where the main incoming 11,000-V feeders enter the works, the existing works compressor house, the Segas plant, the c.w.g. plant, and the new compressor house. The high tension supply is converted to 440 V, 3 phase, a.c. for distribution throughout the works.

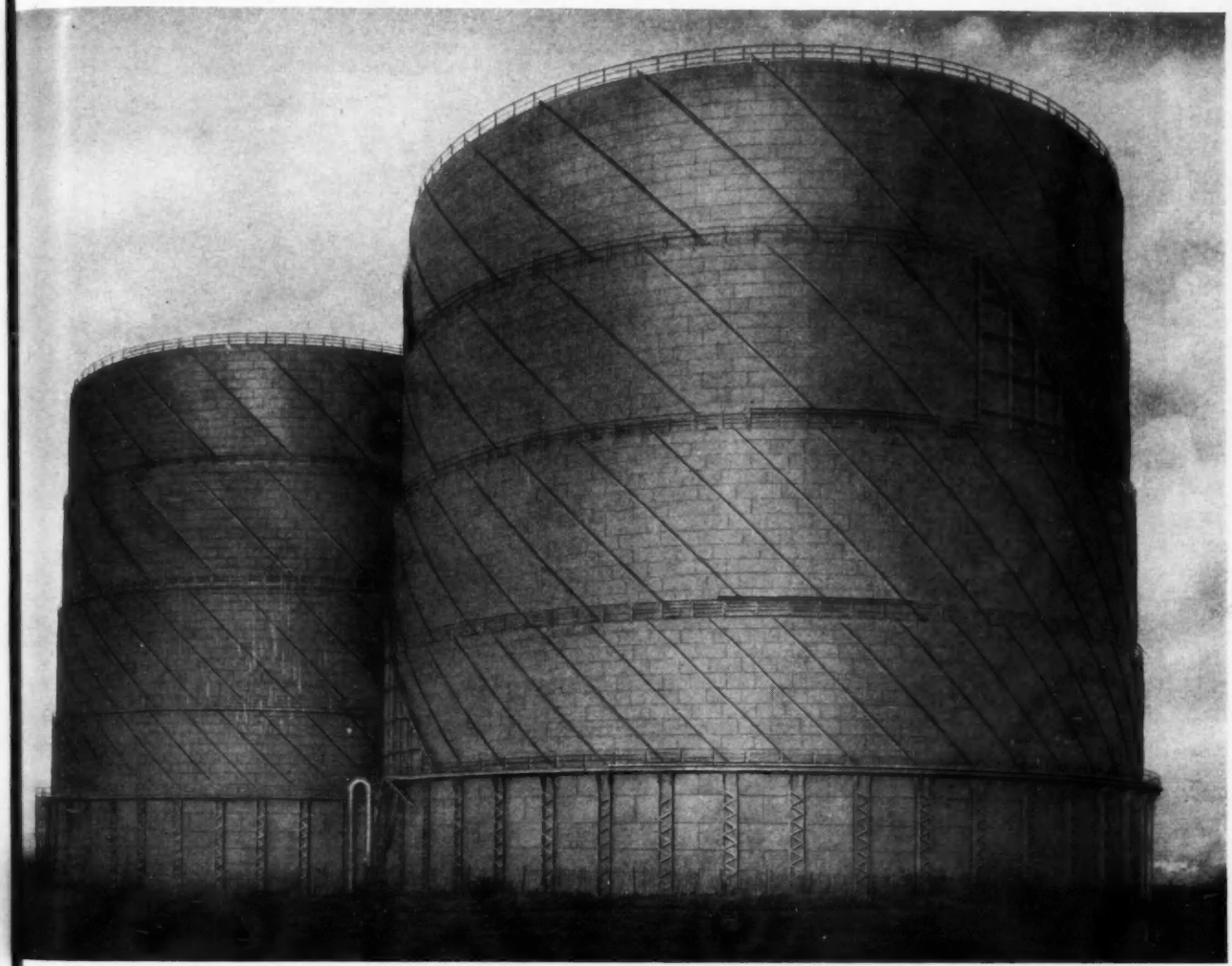
The new compressor plant, the gas mains for which were laid by E. E. Jeavons & Co. Ltd., is situated away from the main works across the river Kennet and is housed in a reinforced concrete building of modern design, with a barrel roof; any windows are formed by glass blocks. The four Bryan Donkin compressors, separated from their power units by a gas-tight dividing wall, supply gas to the high pressure main at 30 p.s.i. Each has a capacity of 250,000 cu.ft. per hour, and two are driven by 500-h.p. National variable speed diesel engines, and two by 500-h.p., two-speed, Lancashire Dynamo electric motors. Also installed in the compressor house are a booster driven by a 75-h.p. Lancashire Dynamo electric motor and a Bryan Donkin diaphragm-type governor. Storage capacity in this part of the works now consists of two 5 mill. cu.ft. holders, the Nos. 5 and 6 holders, one of which is a new holder, but both have been supplied and constructed by C. & W. Walker, Ltd.

Of three lifts, each 43 ft. deep, the new holder has a tank diameter of 205 ft. 9 in. and steel inlet and outlet pipes of 30 in. diameter.

A Simon-Carves gas drying plant of 2 mill. cu.ft. per hour capacity treats all gas passing to the No. 4 holder, the compressors and to the boosters.

THE GASHOLDER IN THE BACKGROUND WAS ERECTED 30 YEARS AGO AND CONTINUES TO GIVE EXCELLENT SERVICE

THE GASHOLDER IN THE FOREGROUND WAS RECENTLY COMPLETED TO AN ORDER FROM THE SOUTHERN GAS BOARD



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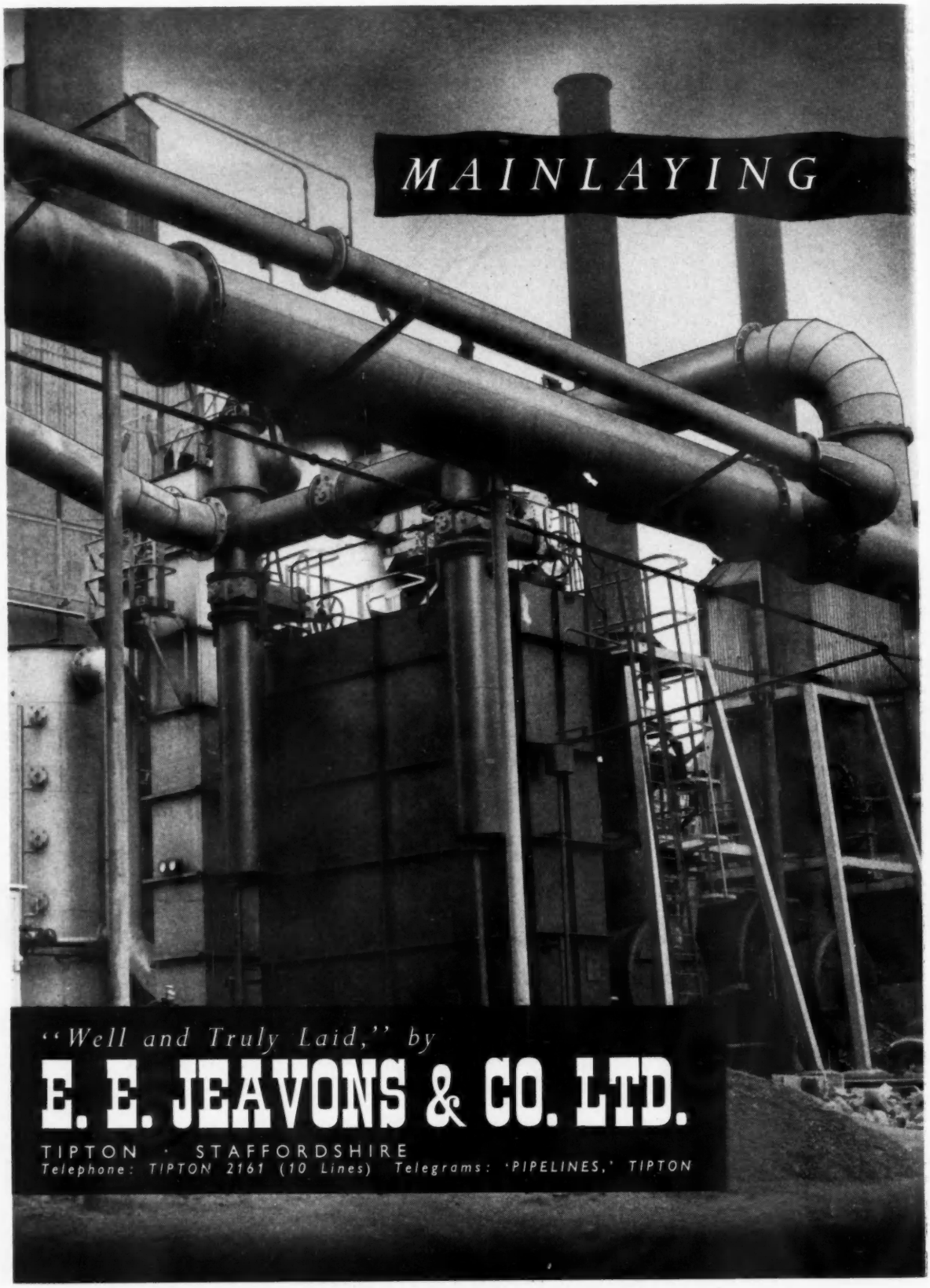
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From a paper presented at the I.G.E. Autumn Research Meeting.

Gas reservoirs in British porous rock structures

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IN recent years, the seasonal storage of very large volumes of gas in underground reservoirs has become a necessary adjunct to the gas-supply systems of many townships in the United States of America; the number of such reservoirs in Europe is increasing, and it seems likely that similar storages would be of considerable assistance to the gas industry in Britain. Particularly this would be the case if gas production were to be concentrated in large central gasification plants and if enrichment were substantially by imported methane. Over the last decade, the Gas Council has endeavoured to assess the probable reserves of natural gas in Britain, and the possibility of using natural gas reservoirs ultimately for the storage of other gases. More recently, the Gas Council has directed its search towards identifying geological structures that could be adapted as gas storages.

Seasonal storage

The British pattern of summer : winter demand is trending in a similar way to the American also with its disproportionate summer : winter ratios at a time of highly competitive selling and steadily rising costs; consequently, much interest has arisen in the exploration of our native resources and the likely manner of using them. The industry has to offer competitive price and superior service, and for both of these aims seasonal storage can play a decisive part, judged by the experiences of other countries.

To date, practically the whole of the change in the daily demand for gas has been provided by corresponding daily manipulation of the production plant, and on this account a considerable amount of uneconomic working has been inevitable, despite the assistance of the more flexible of the available gasification systems.

Bulk storage offers the prospect of requiring less production plant than hitherto, but of fully employing the plant over a greatly increased number of days, thereby reducing the cost of gas manufacture. It also offers the prospect of being able to sustain sudden and prolonged increases in gas demand without recourse to undue stressing of the supply system pending the bringing into operation of any desired stand-by plant.

Bulk storage appears also to be a desirable adjunct to any system of distributing to gas boards methane imported by the ship-load. The added security of having a substantial strategic store of methane would greatly reduce possible transport hazards and, consequently, any reservations that gas boards might justifiably make regarding the extent to which they would wish to embark upon a major methane scheme.

Coal-gasification studies have indicated that the present price of coal offers little prospect of cheap coal gas without the substantial use of cheap enrichment stock. Looking well ahead, it seemed clear that there was a formidable geological problem to be solved in seeking to prove what were the prospects of enlisting native resources of sufficient magnitude to assist the plans for the gas industry of the future.

The storage of gas in the United Kingdom is mainly concerned with holding a reserve to match the disparity between hourly demands and availability of public supplies of town gas. There is also some storage of feedstock and industrial gases, but this is mostly in small quantities.

The bulk storage of gas or liquid in cavities, whether natural or man-made, has attracted interest over a number of years, either for economic or strategic reasons. Natural cavities, by the manner of their formation, are pervious, and coal mines, because of liability to subsidence, can rarely be trusted to store gas at high pressure. Natural caverns and coal mines could be rendered gas-tight at a cost.

Somewhat akin to cavern formation is the commercial practice of producing salt by injecting water down a borehole into a salt deposit at depth and leaching the salt out as brine.[1]

Some interesting constructions are coming into being, both in America and in Europe, by way of man-made underground excavations for the bulk storage of liquefied petroleum gases. In America, the favoured form appears to be as excavated galleries, hewn from impervious hard rock by stall-and-pillar methods as in coal mining. In Europe, the construction of two cavities near Antwerp[2] has been carried out in an impermeable clay which occurs within the depths 75 to 330 ft. The first excavation is being made and fitted with concrete liners to form a chamber at a depth of 250 ft. with a volume of 750,000 cu.ft., and capable of holding 13,000 tons of liquefied petroleum gas.

The real attraction

Man-made structures of the types mentioned have obvious uses for local or strategic storage and possess considerable economic advantages, particularly as feedstock warehouses. The real attraction of bulk storage lies, however, in its capability of storing in the summer substantial quantities of gas which can be recovered to meet winter seasonal or peak requirements. In the general case, a gas board of average size would need to have available storage capacity of the order of 5,000 mill. cu.ft. to supply a fully integrated area distribution system and permit of base-load working by gas-production plant at the appropriately reduced level of installed capacity.

None of the systems mentioned hitherto has anything like this capacity to meet seasonal requirements, and some entirely different concept needs to be considered for such purpose.[3]

The search in Europe for underground storage sites, preferably close to centres of consumption, has usually followed an earlier search for oil and natural-gas reservoirs.

The Lacq gas in its natural state is highly sulphurous and corrosive and needs to be immediately purified. To maintain an adequate supply of purified gas at all times requires the services of a substantial storage, and this has been achieved by the construction of an aquifer at Lussagnet.

In Germany, one underground storage, for refinery gas, makes use of an oil- and gas-field near Hamburg.[5] Another underground storage, near Hanover,[6] makes use of an aquifer for the seasonal storage of surplus coke oven gas from the Ruhr; a second aquifer storage is to be constructed at Darmstadt for coke oven gas.

For successful operation of a natural underground gas storage, the reservoir rock or sand must be of substantial volume. A good average requirement would be a total volume of 3,000 mill. or 4,000 mill. cu.ft. such as would be available under a cover of 1 sq. mile if the sand were 125 ft. thick or, say, 5 sq. miles if the sand were 25 ft. thick. High porosity is necessary for economy of space and ease of working, and this condition is favoured by uniform grain size in the rock structure; too wide a range of grain sizes tends to reduce pore space. Porosity, as the ratio of pore space to total volume, measured dry, is usually of the order of 30 to 45% and rarely exceeds 50%.

Adequate cap-rock

The reservoir must be covered by an adequate and completely impervious cap-rock, which must also provide sufficient side closure to permit of working at the desired pressure. The impervious cover may be a solid rock, or a heavy clay that is permanently wet because it is the water-table for the porous layer that it supports. Sometimes the cover is an anhydrite layer or an evaporite as a heavy deposit of salt, either of which, in the absence of faults or fissures, provides gas-tight conditions.

The natural kinetics of storage derive from the standing head of water between the level of the outcrop at the surface of the porous stratum and the level of the water-table in the structure.

The whole system of aquifer storage can be likened to a U-gauge with a long open limb and a short closed limb, both filled with water. The long limb represents the water column up to the outcrop source, and the short limb represents the closed reservoir standing under a pressure appropriate to the length of the open long limb. It will be apparent that there can be no free space within a reservoir. A hydrocarbon trap is full of natural gas or oil, and an aquifer is full of water.

If the cap-rock is pierced by boring down from the surface, the pressure within the reservoir will be released up the borehole and the contained gas or fluids will flow according to the hydrostatic head.

Aquifers do not contain pressures additional to what is derived from the natural head provided by the outcrop water source. The water resident in the porous stratum can be expelled by pumping gas down a borehole drilled into the highest point of the structure. As the gas bubble around the base of the borehole grows under the crest of the cover by continued injection, so the water tends to be pushed out towards the edge of the dome or anticline where it spills into the water-table and courses away down stream if there is such a way, or it backs up the outcrop if there is no spill-way.

The crucial factor affecting the worth of a gas storage is the maximum rate at which it can deliver stored gas back to the distribution system. This rate is dependent upon the extent to which reservoir pressure can be maintained during prolonged periods of substantial withdrawal.

When an aquifer is to be filled with gas by the pressure displacement of the water, the operation can be likened to filling the top lift of a conventional water-sealed gasholder. The water must not be displaced beyond the spill point which is the edge of the reservoir. The extent of the closure is its linear depth, and in the case of a natural reservoir this measure has to be ascertained as an essential part of the geological investigation.

A desirable depth for reservoir storage, having regard for economy of space and gas compression, is of the order of 750 to 1,500 ft., with an expected static pressure of 20 to 45 atmospheres. Gasification process and gas trunk main pressures of the future will probably approach this range and so the amount of compression to operate a storage need not then be inordinately high.

Storages of the kind under review are expected to have an operational capacity of the order of 10 to 12,000 mill. cu.ft. of gas, so five or six such storages in the United Kingdom would suffice to supply all the additional winter seasonal demand for gas. According to size, two or more area gas boards could be mainly served by one storage on some such demand pattern as 40 days' delivery at 100 mill cu.ft. per day and 100 days' delivery at 70 mill. cu.ft. per day, with the remaining winter days marginally in balance.

The top of the well is finished off in a concrete cellar, which may be closed by a steel cover at ground level and, therefore, be practically unobservable. Alternatively, the well may terminate just above the ground level so that the valve gear can be operated at hand height. In such cases, the head works are usually protected by some form of stout wire fencing.

It is probable that in most instances the gas will need to be compressed before, and possibly after, storage and there will, therefore, be the need to install a dust- or sand-filter before the compressors, and an oil-fog separator and a cooler after the compressors.

Hydrogen cyanide, if present, can be removed conveniently in contact beds of a mixture of copper oxide and sodium bicarbonate. It is also necessary to remove from the gas any compounds liable to form gum, which could cause blockage of the porous zone adjacent to the wells. Such compounds are mainly the condensible hydrocarbons and the oxides of nitrogen, which together, under appropriate conditions of time, pressure and humidity, have been mainly responsible for some of the reported instances of undesirable side effects. Purification can be undertaken in an active-carbon plant with the appropriate carbon-regeneration system. The gases from the depressurising of the adsorber vessels and from the regeneration system can be utilised as process fuel. Finally, the gas leaving the active-carbon plant needs to be filtered for the removal of carbon dust and then measured through the station meters and passed to the storage wells.[7, 8, 9]

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DISCUSSION

Mr. N. L. Falcon, B.P. Exploration Co. Ltd., said that about four years ago, his company had advised the Gas Council that the chances of finding big accumulations of natural gas were small. After that, interest had turned to gas storage. There was no difference, in fact, between the work they did in exploration and the work which the Gas Council were now interested in for storage.

There was, however, one other thing which distinguished exploration from storage. Boyle's Law made it clear that a reservoir at high pressure under a considerable overburden, could contain far more gas than if it was at, say, 1,000 ft. Their early explorations had had to use a seismic exploration tool which made the exploration fairly expensive, simply because they had been interested in things at a depth of 4,000, 6,000 or 8,000 ft. A series of holes could not be drilled to 8,000 ft. extremely economically, so other exploration tools must be used in order to investigate it.

But the Gas Council were now interested in structures at a depth of something of the order of 1,000 ft. or 1,500 ft. Structures at these depths could not be explored with the seismic tool; it was impracticable, so a return had to be made to the oldest method of all of exploring structures, namely to drill holes to some key bed so that the actual contour of the trap could be drawn out.

As a geologist who had been concerned for quite a number of years with explorations for hydrocarbons in this country as well as countries overseas, and so with a fairly good idea of the underground geology of Britain, he thought the chances of finding the kind of traps described by Mr. Johnson which were now being investigated, were extremely good. Due, however, to the process of the evolution of the country, the suitable conditions for the formation of traps had not occurred in those parts where the Gas Council wanted them to be.

There were many sorts of structures known to exist, in parts of the country which were a little too far off for the Gas Council's purposes, but the construction of the grid had altered this and there were now far more potential gas storages coming into the areas in which the grid was being constructed.

It was not possible to carry out exploration work anywhere in this country without opposition, and the major opposition always concerned amenities. There was always an outcry as soon as anyone started to bore a hole. There were 12 producing oilfields in the country and in spite of advertising campaigns, and references to them at technical meetings, only 12 or 15 people had actually seen the installations, so it could be easily imagined that there was not very much to be seen.

From his knowledge of the problems, he felt confident that no more would be seen of an underground storage than was seen in exploration operations, so there was no risk of spoiling the amenities.

Dr. A. E. Haffner, Chief Engineer, Southern Gas Board, said that broadly speaking, seasonal underground storage became attractive:

1. The greater the winter-summer gas ratio.

2. The greater the rate of sales expansion, because it avoided expenditure on new plant to meet new loads.

3. The cheaper the base load gas per unit volume. Cheap gas involved less capital expenditure and natural gas was likely to be more attractive in those countries where it was indigenous, than manufactured gas was likely to be.

4. The lower the additional compression costs to store the gas underground. If gas had to be compressed to 900 p.s.i. for instance, a lot of money might have to be spent on compression, but if it was already available at or near this pressure—either generated or obtained from natural gas wells at high pressure—additional pressure costs would be very small indeed.

5. The greater usefulness of the pressure in the stored gas.

6. The higher were production costs of gas to cover the winter and peak demand.

In all these six items, foreign conditions had usually provided a greater incentive towards earlier development of seasonal storage. In the first two items—winter-summer gas ratio and rate of sales expansion—cause and effect were closely interconnected, for cheap underground storage lead to the possibility of meeting a very big seasonal load, and with that came the possibility of increasing gas sales.

However it was hidden in costs, gas cost 1d. per therm to store overnight in conventional storage; if only used at weekends, it cost 7d. a therm to store. If any gas had not been used or was only used once a year, it cost 365d. to store. The Northern Gas Board were therefore attracted to develop salt cavity storage for weekend surpluses of coke oven gas stored at a cost of 2d. per therm instead of 7d.

If 10% of the annual output only was stored and used only once a year, this added 36.5d. per therm to the cost of all the gas made. But it could be done attractively with seasonal storage in underground systems or aquifers because the capital costs of aquifers had been shown to be about £4.6 mill. for 12,000 mill. cu.ft., about 1/250 or 1/300 of the capital of conventional storage. Capital amounting to £4.8 mill. would be needed to withdraw 120 mill. cu.ft. of gas per day, equivalent to £40,000 per mill. cu.ft. and the author suggested that production plant costing £150,000 per mill. to do the same thing would be avoided.

There were many variations in the possible schemes, and the Underground Storage Panel of the Gas Council had studied a number. There was not even one answer to the cost of underground storage, there were even more answers to the amount of money it would save, and it all depended on the six factors mentioned earlier.

The Chilcomb anticline near Winchester had had five deep exploratory wells sunk and they had confirmed the indications of surface geology that there was a structure of the right shape with about four different strata at different levels worthy of consideration for storage of one sort of gas or another, or several gases.

Legislation would be necessary before gas injection could start, and if passed injection would begin with town gas from a nearby trunk main available at 50 p.s.i.g. It would have to be compressed to something like 450 p.s.i.g. suitably purified and directed down the summit well at the anticline.

The slow rate of filling would test one's patience beyond endurance but for the promise that, once inflated, there would be relatively little movement of the water barrier and seasonal injections and withdrawals of gas would come about more by rise and fall of pressure than by increase and decrease in the size of the bubble.

The storage system would yield gas at about 350 p.s.i.g. in the first part of the winter season, falling to 175 p.s.i.g. towards the end—that is with half the gas being withdrawn. This pressure would be sufficient to feed back to the pipeline without using the compressors in reverse.

Elsewhere in the world, refinery gas and natural gas were also stored, and there was a potential development in the lower strata at Chilcomb in this direction.

With a successful underground storage, production plant would become temporarily in excess of requirements, and

obviously the most obsolescent plant would have to be the first to be discarded.

Seasonal storage on a massive scale was an advantage not enjoyed by any of their competitors. All plant, or a high proportion of it, would be operated at level load tuned to maximum efficiency and producing gas of constant combustion characteristics to satisfy even Watson House. It would be maintained on a year-round basis and manned by operators whose duties and pay would not be subject to seasonal variation.

Mr. G. U. Hopton, Director of the London Research Station, said that he and his staff had the task, as part of the work on underground storage, of studying the chemical problems which would arise, problems which might be classified under the three heads of possible changes in the gas, the rock structure, and the water. In the design of plant for underground storage, the required treatment of the gas to prevent deterioration of the storage characteristics of the sand must be considered, and gas withdrawn from storage must be free from anything likely to cause trouble on distribution.

The possible effect of gas storage on water supplies had received the most careful study, and he proposed to devote the time at his disposal to this subject.

Possible contaminants of water to be considered were —phenol, di-enes, organic sulphur, benzene, hydrogen cyanide, and hydrogen sulphide—the last only if formed during storage. The maximum concentrations of these constituents were known, and their partition factors served as a basis for the following considerations.

The gas bubble might be regarded as a cylinder about a vertical axis, surrounded by water-logged sand, and closed at top and bottom by impermeable clay. In its expansion on filling, the gas would pass through the sand, which would act as a vast radial chromatographic column absorbing contaminants from the gas.

It had been calculated that the height of an equivalent theoretical plate was 10 ft. Of the various contaminants in gas, phenol was the most strongly absorbed, its partition factor for sand to gas being 66,000. It was then calculated that the concentration of phenol in the gas would be reduced to 10^{-13} of its original concentration after five plates—i.e., 50 ft. Benzene was the least strongly absorbed, its partition factor for sand to gas being only .2. It had similarly been calculated that the concentration of benzene in gas would be reduced to 2×10^{-4} of its original concentration after 80 plates—*i.e.*, 800 ft.

These concentrations in the gas were so low that water in equilibrium with it at a radial distance of 800 ft. would contain undetectably minute concentrations of the constituents. And it must be borne in mind that a radius of 800 ft. was small for underground storage.

So much for the conditions at the edges of the gas bubble, but to make the calculations as conservative as possible, he would pretend that the concentrations of contaminants in the water at the edge of the bubble were in equilibrium with the original concentrations in the gas. Using this unfavourable and untrue assumption, the rate of diffusion through intergranular spaces in water-saturated rock might then be applied to find the time required for the concentration of diffused contaminants to reach an undesirable level at a given distance from the edge of the bubble. It was found that this time was 10 years to travel 3 ft., or 1,000 years to travel 30 ft. These very low diffusion rates had been confirmed by observation over a period of 10 years by the Institut Français du Petrole.

It might be argued that the net amount of contaminant in the reservoir would increase over a period of years due to seasonal withdrawal and injection. But the gas withdrawn would be in equilibrium with the inner plates—if he might use the phrase—and would therefore carry out as much contaminant as was brought in.

The possibility that the rate of contaminant travel might be increased by water movement inwards and outwards during withdrawal and injection of gas had also been considered, but this movement would in fact be very slight. They were going to deal with Boyle's law and not with permeability when the reservoir had once been filled.

If the most unfavourable case was taken once again, chromatographic effect neglected, and the sand re-traversed by the water assumed to be in equilibrium with the original gas, the movement would increase from 3 to 3.3 ft. in 10 years, or from 30 to 33 ft. in 1,000 years.

Finally, the hydraulic gradient might cause the water to flow past the bubble. This was a matter on which water engineers and other experts should be consulted, but his own view was that any contaminant picked up from the bubble—and he did not believe that contaminant would reach the edge of the bubble—would be removed by absorption on the sand during passage of the water to the surroundings. Complete freedom from contamination had been found to be the case at Beynes, Engelbostel and Reitbrook, where regular tests were made at water wells in the vicinity.

Mr. A. B. Densham, London Research Station, said that [Fig. 12 on p. 18] was based on the practice at Beynes, but he hoped that it could be considerably simplified on the into-storage side in this country. There was no hydrogen cyanide extraction plant at Engelbostel, and hydrogen cyanide would be so strongly absorbed by the sand that the small amount in the gas could not contaminate any water supplies.

Nitrogenous gum also appeared to be an imaginary bogey, and arose from unfortunate experiences at Pittsburgh in the early 1930s, when unpurified coke oven gas containing 5 ppm. of nitric oxide had been stored in a disused oil field, and there had been trouble with nitrogen gum. It had been found unnecessary to use an active carbon plant at the inlet at Engelbostel, and it was not proposed to use one at the inlet to the new reservoir at Darmstadt.

Tests in which Southampton gas was passed through cores of Winchester Lower Greensand, at a static pressure of 330 p.s.i.g., had shown no blocking by gum in two months. Condensation of liquid hydrocarbons, with possible formation of liquid-phase gum, could best be avoided by thorough benzole washing at the gasworks.

The humidifier, hydrogen cyanide extraction plant, cooler, active carbon and carbon dust filter could thus be eliminated from the top of [Fig. 12].

On the out-of-storage side, it would be necessary to provide plant for hydrogen sulphide removal, as at Beynes and Engelbostel. The Gas Council bacteriologist, Miss Pankhurst, had shown that sulphate-reducing organisms did exist in small numbers in the Wealden Sand D at Winchester, and that they would be able to develop there in a town gas atmosphere, but were less likely to do so if methane was stored. Hydrogen sulphide might also be formed from the carbonyl sulphide in the gas or the iron sulphide in the sand.

Plant would also be required for removing nickel and iron carbonyls. Carbonyl formation, up to a few ppm., had been observed at Beynes and Engelbostel. Experiments had shown that Southampton gas, stored for a fortnight over Winchester Lower Greensand, at 330 p.s.i.g., in an aluminium cylinder, contained 45 ppm. of nickel carbonyl. This was surprising because the sand only contained .0004% of nickel, but calculation showed that this was enough to raise the carbonyl content of 200 reservoir fillings with gas to 45 ppm. As little as .03 ppm.

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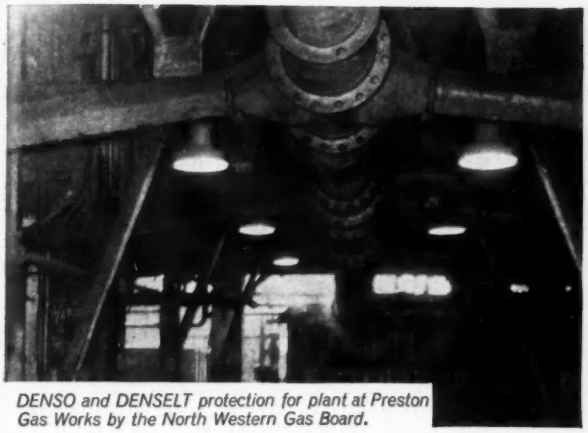

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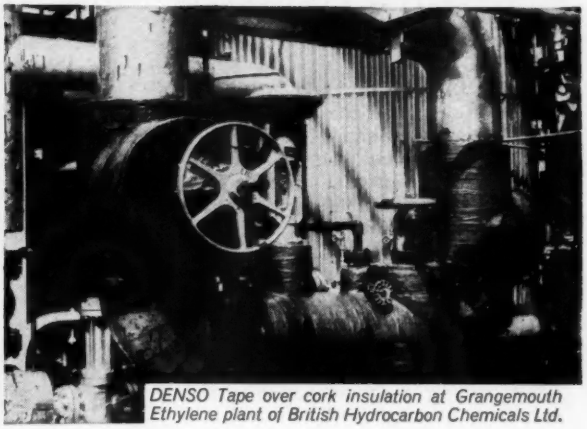

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of nickel carbonyl would cause sooting of sensitive burners.

The carbonyls were removed with active carbon at Beynes and Engelbostel. Nickel carbonyl was more volatile, boiling at 44° C, and at Beynes, it was necessary to dry the gas to a dew point below 5° C. under pressure to obtain adequate removal. Thus the cooler should be before the active carbon in the lower half of [Fig. 12].

On the other hand, rebenzolising should be unnecessary if the active carbon plant on the into-storage line was eliminated. Any minor changes in calorific value could best be adjusted, if necessary, by addition of butane or air.

Mr. L. J. Clark, Assistant Chief Engineer, North Thames Gas Board, said that in their very severe competitive position the cost of a peak load therm was one of outstanding importance. Here was an opportunity of improving the situation; the peak load therm could be stored. The figures published for the Beynes underground storage near Paris showed that the cost per therm stored was a little over 4d, and there had been special cases there in which the gas had had to be specially purified, and gum formers, sulphur and such like impurities removed, but it was still quite expensive.

There were other ways in which their therms could be stored. L.p.g. could be stored in tanks in refrigerated form above ground and the costs there were likely to be rather lower than 4d. a therm, but the material still had to be processed for supply to the consumer.

There had been proposals put forward for storing methane in the ground in excavated holes, the holes being self-supporting by the ice formation in the wall of the subsoil. This also offered attractive means of storing peak load gas and the cost should be lower than the l.p.g. refrigerated storage.

The costs were in its favour because, in the first place, a gas of 1,000 B.t.u. per cu.ft. was being stored, and so the cost per unit volume of store space underground was twice as effective as it would have been for a 500-B.t.u. gas.

Secondly, the gas was perfectly pure; the sulphur content was extremely low; and the risks of contamination were very, very small.

Thirdly, one of the substantial costs of any underground storage was that of compression, but this could be obviated when applied to liquid methane. The liquid discharged from the ships and stored in the terminal insulated storage tanks could be pumped as a liquid into the evaporators, converted into gas and then distributed at high pressure through the transmission lines to the storage. The energy required for the compression under these conditions was less than 1% of the energy required to compress methane as a gas.

These factors combined should mean that it was possible to store methane underground at quite a low cost by comparison with the Beynes installation, where manufactured town gas was stored. This was important.

Underground storage was another case of applied practical research, as indeed was the liquid methane project.

Referring to Sir Charles Ellis' paper of the previous day and the need for tremendous resources and a tremendous amount of work, both for the methane scheme and underground storage, he referred to the necessity for free interchange of information between research establishments, not only in this country but wherever contact would be made in the world. Already communications were excellent but they should be taken even further. Though the Gas Council and the area boards, research stations and contractors, all had a great part to play, he suggested that there should be some interchange at the lower levels, between people in area boards and research stations, so that there could be some circulation of information at these levels.

This was important because the need for pressing on was still very, very great; the methane project was just a beginning, and with the competitive situation in the industry, it was so much later than some might be inclined to think.

Germany: Long distance supply

THE Ruhrgas A.G. has stated that it will raise a note loan of 40 mill. DM. This sum is necessary for the financing of new tasks relating to the development of natural and refinery gas for the long distance supply.

The reserves of natural gas in the German Federal Republic are estimated at 35,000 mill. cu.m. For the supply of natural gas abroad it is necessary that very great quantities should be disposed of and that the distances involved allow transport to be both technically and economically possible.

The improved municipal gas plant at Ulm now produces 40,000 cu.m. daily, of which 60% is from coal and 40% from oil.

German gas experts declare that the gas engine might be of real value in Germany, where it was once developed as the conventional source of power. In combination with the natural gas, the gas engine could be used for special purposes in the chemical industry and for the long-distance gas supply.

October 26 was the day on which Ruhrgas AG. was to complete the connecting up of a second natural gas pipeline from Emsland to its plant at Dorsten over a distance of 100 km.

In the French newspaper *Le Monde*, M. Pierre Uri gives an interesting survey of the importance of the Sahara as a reserve for petroleum and natural gas. The reserves of natural gas are, he writes, very big but the costs for its transport are so high, that the market for the gas must also be on a very big scale; the market in fact must include the whole of Europe with Great Britain, supplied by methane tankers and France, the Benelux States and Germany by pipeline. The Sahara must therefore be placed under an international system which will guarantee its financial stability. For France alone this would only be a burden. It would therefore be better to establish a common system in which France-Algeria, the other countries of Africa and Europe were partners. M. Uri concludes his article with this statement: 'The Sahara will be international or not at all.'

The total length of the Ruhrgas AG. Essen pipelines at the end of 1960, was 2,422 km., including those pipelines under joint ownership with other companies. Cathodic protection of the pipeline from corrosion was extended to 650 km. So great is this firm's experience in this kind of corrosion protection that a great many orders both from Germany and abroad were received and carried out. The total quantity of gas supplied by Ruhrgas AG. in 1960 amounted to 5,326 mill. cu.m.

Methane: 'This bold scheme'

GAS CHIEFS DESERVE CREDIT FOR COURAGE INITIATIVE, VISION

—Parliamentary Secretary

MEMBERS of the Gas Council and the chairmen of the area boards merited a great deal of credit from the House for the courage, initiative and vision they had shown in 'this bold scheme,' said Mr. John George, Parliamentary Secretary, Minister of Power, replying to an adjournment debate initiated by Mr. James Boyden (Lab. Bishop Auckland) on the scheme to import liquid methane from the Sahara.

Mr. George said the Minister of Power had never considered that the study of the Lurgi proposition was in any way prejudiced by the fact that permission had been given to import methane.

The study group would report, within a few months it was hoped, and then—and only then—would they have any idea about the price at which the group considered that the Lurgi plant could supply gas to consumers in this country.

'IN ALL SINCERITY'

He said: 'I can give an assurance—which I have given before—that the Gas Council entered into this study group in all sincerity. It is anxious that the truth about Lurgi should be known, and if, in the end, Lurgi is shown to provide a cheap, competitive and safe method of generating gas, then the Lurgi plant will come into the boards' development plans.

'While one can criticise the import scheme, the Minister is content that the Gas Council, with its business acumen and commercial wisdom, has made arrangements which are sound.

'He is not in the slightest bit worried if the French banks are not advancing money in Algeria, because the Gas Council has not a penny invested in Algeria.

U.K. INVESTMENT

'The whole of the Council's investment is in the United Kingdom. Its commercial acumen has been brought to bear to such an extent that others carry all the risk outside the United Kingdom.'

Mr. George said that the Gas Council was entitled to a great deal of credit for all the foresight, vision and patience it had shown during the long and difficult negotiations.

'The result has been a great upsurge in the morale of the industry, which has passed through a difficult period from the time of nationalisation until recently. This is the first ray of light this industry has seen, and the effect on the coal mining industry will not be serious but only marginal.'

Mr. Boyden had said: 'The heart of the matter is the sudden decision to allow the Gas Council to sign the new contracts when the Lurgi report is nearly ready. Why did the Minister not tell the Gas Council that he would come to a decision on the signing of the contracts when the Lurgi report was ready?

'The Gas Council has been taking its time about finishing the report. I understand that it has only one technical officer dealing with the matter. Perhaps the absence of appropriate technical staff in his own Ministry is a weakness which has delayed the Lurgi report.'

FIRM HOLDS SAFETY TALKS

STAFF employed in various parts of the British Isles by Simon-Carves Ltd. and its subsidiaries attended a one-day safety officers' conference at Cheadle Heath, Stockport.

About 50 delegates were welcomed by Simon-Carves Director, Mr. H. V. Peeling, and introduced to their Chairman for the session—Mr. P. Archer, the company's Chief Contract Labour Officer.

NEWS SUPPLEMENT

Norway Week helps gas

THE north-east coast has always enjoyed a close association with Norway and this was extended by the recent staging of Norway Week in the Tyneside, Wearside and Tees-side areas.

The highlight of the week was the visit to this country in support of this activity by King Olaf of Norway.

This tie-up captured the imagination of the public and most large organisations gave support to the Norwegian theme.

The Northern Gas Board staged an exhibition of 'Norway Design' in their demonstration theatre in the main showrooms at Newcastle.

COOKERY SHOWS

Cookery demonstrations created considerable interest among the general public and an information bureau was situated in the main showroom and staffed by a Norwegian lady in national costume.

The design exhibition was opened by Mr. Arne Skaug, Norwegian Minister of Commerce, who was introduced on this occasion by the Chairman of the Northern Gas Board, Mr. E. Crowther, C.B.E. Also present on this occasion were many local dignitaries and included the Mayors of Oslo and Bergen.

An interesting aspect of this exhibition was that many thousands of the public were encouraged to visit the main gas showrooms in Newcastle during the week.

DESIGN EXHIBITS

Aspects of the Norwegian Design Exhibition staged in the gas showrooms, Newcastle-on-Tyne.

PERSONAL NOTES

MR. FRANK HARVEY, general manager of the Walsall and District division of the West Midlands Gas Board, has been appointed Engineer of the Lurgi plant which the Board is building at Coleshill. Mr. Harvey, who is 48, is Chairman of the Midlands Section of the Institution of Gas Engineers. He entered the gas industry at Dudley in 1932, and was subsequently deputy engineer and manager at Bilston, holding the latter position during the war. Later, he became group engineer for the Grimsby Group of the East Midlands Gas Board. In 1953, he was appointed deputy manager of the Walsall division of the West Midlands Gas Board and became divisional general manager in the following year.

MR. JAMES WARD has been appointed Group Industrial Engineer of the North Western Gas Board Manchester Group, in succession to MR. WALTER HOWELL who has been appointed Technical Sales Manager at Board H.Q. Mr. Ward, who is 46, was assistant distribution superintendent at the Preston gas undertaking when the gas industry was nationalised, and was then appointed senior industrial engineer of the Board's Preston Group. Until 1960 he was group industrial engineer of the East Lancashire Group. In January 1960 he moved to Manchester as deputy group industrial engineer.

MR. T. G. HARDY has been appointed Transport Manager of the North Thames Gas Board following the recent death of MR. E. S. CAPLIN. MR. E. B. H. ELSBURY is Deputy Transport Manager, and MR. P. N. GREEN is Superintendent, Motor Repair Shop, Brentford. Mr. Hardy has spent 30 years on the transport side of the gas industry. He became deputy transport manager in 1951. Mr. Elsbury was appointed manager in the Motor Repair Shops at Brentford in 1948.

MR. F. L. WARING, managing director of the Coalite Group of Companies, has been elected Deputy Chairman of the Group. A past chairman of the Yorkshire section of the Institute of Fuel and the immediate past president of the Association of Tar Distillers, Mr. Waring is also Vice-Chairman of the Chemical and Allied Industries Joint Industrial Council.

COMING EVENTS

December 12. — MIDLAND JUNIORS: Short Paper Evening. Staff Mess Room, West Midlands Gas Board, Birmingham District, Council House, Birmingham.

December 15.—LONDON AND SOUTHERN JUNIORS: 'Retrospect on American Visit,' by S. B. Scott.

MR. L. ROSE, M.C., a Director of Schweppes Ltd. and Chairman of L. Rose & Co. Ltd., is to be the next President of the Food Manufacturers' Federation Incorporated. He succeeds MR. J. P. VAN DEN BERGH, C.B.E., a Director of Unilever Ltd. on the completion of his three-year term of office.

ALDERMAN G. B. NORTON, of Dudley, Worcestershire, COUNCILLOR W. J. OWENS, of Rugeley, Staffordshire, and MR. C. G. PETTIT, of Shenstone, Staffordshire, have been appointed members of the West Midlands Gas Consultative Council.

ALDERMAN C. M. NEWTON, M.B.E., of Overstone, near Northampton, and COUNCILLOR W. ALBANS, of Scunthorpe, have been re-appointed part-time members of the East Midlands Gas Board.

MR. W. A. CAMPBELL has been appointed Deputy Engineer of the Belfast gas undertaking. Mr. Campbell was principal administrative and technical officer in the gas department. He has been there since 1932.

MR. R. E. ANSELL has assumed the title of Sales Director and MR. C. BOWLES has been appointed Sales Manager, responsible to the sales director of Henry Wiggin and Co. Ltd.

MR. O. R. GUARD, of Liphook, Hampshire, has been re-appointed a part-time member of the Southern Gas Board.

COUNCILLOR C. W. MORLEY, of Derby, has been appointed a member of the East Midlands Gas Consultative Council.

THE INSTITUTION

and Junior Associations

THE Annual General Meeting of the South Western Section of the Institution of Gas Engineers was held at Bristol recently. The proceedings were presided over by Mr. T. W. Jackson, Chairman, who welcomed Mr. A. G. Higgins, Secretary of the Institution, and Mr. C. H. Chester, C.B.E., Chairman of the South Western Gas Board.

The following officers were elected for the ensuing year:—Chairman, Mr. R. J. Williams; Senior Vice-Chairman, Mr. T. W. Clapham; Junior Vice-Chairman, Mr. W. Dougall; District Member of Council, Mr. T. W. Jackson; Honorary Secretary, Mr. F. C. Gay, M.B.E.; Honorary Treasurer, Mr. T. A. Nicholson.

TRADE NOTES

HONEYWELL CONTROLS LTD. has begun producing 'made-to-order' automatic control systems at its new 32,000 sq.ft. factory at Hemel Hempstead. Among products to be made there are units for scanning and logging data for industrial operations, controls for industrial processes, supervisory control panels for air-conditioning and ventilating systems, and parts for full-size Honeywell electronic computers.

METAL AND PIPELINE ENDURANCE LTD., which specialises in cathodic protection and welding inspection, has recently formed an association with the Hume Pipe Co. (South Africa) Ltd., the largest pipe suppliers in South Africa. Mr. J. E. Hay, of MAPEL, is shortly leaving for South Africa to assist in setting up an organisation.

TURNER & NEWALL LTD. proposes to expand the scope of its subsidiary in South Africa, Turners Asbestos Products (Pty.) Ltd. A new factory is to be built in Durban which will house a new plant for the manufacture of asbestos cement sheeting and the asbestos cement pipe plant which is at present located at Driemanskap, Transvaal.

OXLEY ENGINEERING CO. LTD. has moved its London office from Winchester House, Old Broad Street, E.C.2, to 57, Tufton Street, S.W.1. Telephone: ABBey 2661.

CAMBRIDGE INSTRUMENT CO. LTD., has opened a new instrument assembly wing at Cambridge. It represents an additional 15,000 sq.ft. of production space.

Annual General Meeting

To fill the vacancies on the Management Committee, the following were elected as ordinary members: Mr. F. Tweedle and Mr. R. Pratt, who will be retiring in 1964, and Mr. P. J. Whitehead, retiring in 1963.

Mr. P. A. E. Wallis, an Associate of the Institution, was elected a member of the Section. The Chairman presented a certificate of associate membership of the Institution of Mr. G. F. Williames.

Mr. Jackson introduced the new Chairman of the Section, Mr. R. J. Williams, who presented Mr. Jackson with his past chairman's badge to commemorate his year of office, together with a framed 16th Century map of Gloucestershire.